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(54) **FLOW RATE MEASURING DEVICE AND PROGRAM FOR THE DEVICE, METHOD OF MEASURING FLOW RATE, AND FLUID FEED SYSTEM**

(57) There is provided a technique for accurately identifying an appliance which uses the fluid from a viewpoint of the range of a change in flow rate value. An ultrasonic flow rate measuring device 7 measures a flow rate value of gas flowing in a flow passage 6 of a gas meter 16, and a measured flow rate information storage section 8 stores a measured flow rate value. A meas-

ured flow rate value difference calculation section 9 calculates a measured flow rate value difference within a predetermined period corresponding to an amount of change occurred in a measured flow rate value. An appliance identifying section 11 identifies an appliance which uses the fluid or leakage by determining whether or not the measured flow rate value difference is a predetermined threshold or less.

FIG. 3 (a)

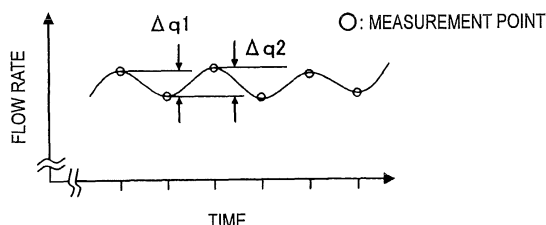
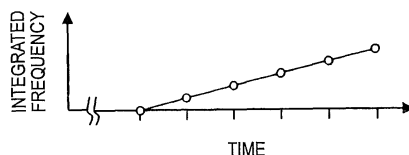


FIG. 3 (b)



Description

Technical Field

[0001] The present invention relates to a technique for identifying an appliance which uses the fluid or leakage by utilization of a change in a flow rate of fluid.

Background Art

[0002] As shown in Fig. 8, a flow rate measuring apparatus of this type has a gas flow rate measurement unit 1 that measures a flow rate of gas flowing in a gas flow passage; a flow rate increase detection unit 2 that detects an increase in flow rate on the basis of a measurement result; a flow rate increment/decrement detection unit 3 that detects an instantaneous incremental/decremental change in gas flow rate according to an increase in flow rate; an appliance identifying unit 4 that determines initiation of use of a new gas combustion appliance when the instantaneous incremental/decremental change is detected; and a flow rate registration unit 5 that registers the increase in gas flow rate detected by the flow rate increase detection unit as an increase in the flow rate of gas arising from initiation of use of the new gas combustion appliance (see; for instance, Patent Document 1).

[0003] Attention is paid to the fact that, when use of a new gas combustion appliance is initiated, an instantaneous incremental/decremental change in the flow rate of gas is followed by a stable gas flow rate, initiation of use of a new gas combustion appliance is determined by the above configuration at the time of determination of an incremental/decremental change, thereby enabling determination of initiation of use of a new gas combustion appliance by means of a simple method and registration of an increase in gas flow rate arising from use of the new gas combustion appliance.

[0004] However, the related-art configuration encounters a problem of uncertainty about whether an increase in flow rate is induced by an already-existing appliance or as a result of use of a new gas combustion appliance.

[0005] In order to solve this problem, a flow rate measuring apparatus shown in Fig. 9 has an ultrasonic flow rate measuring device 7 serving as a flow rate measurement section that measures a flow rate in a flow passage 6; measured flow rate information storage section 8 that stores a flow rate value of the ultrasonic flow rate measuring device 7 and time information; a learned appliance registration unit 21 that registers measured flow rate information measured for a given period of time as appliance flow rate information; an appliance flow rate information storage section 22 that registers and stores the measured flow rate information; and an appliance identifying section 11 that compares measured flow rate information in the measured flow rate information storage section 8 with appliance flow rate information in the appliance flow rate information storage section 22, thereby

identifying an appliance. Reference numeral 12 designates a number-of-appliances determination unit; 13 to 15 designate gas appliances; 16 designates a gas meter serving as a flow rate measuring apparatus; 17 designates a flow passage shutoff valve; 18 designates an operation section; 19 designates a gas pipe line; and 20 designates an appliance-specific flow rate calculation unit (see Patent Document 2).

[0006] The flow rate measuring apparatus can store and register measured flow rate information and determine usage states of a plurality of appliances and can specify an appliance to be used, so long as types of the appliances (a hot water supply, a gas cooker, and the like) are registered in advance. At that time, a change in start-up flow rate, an absolute flow rate value, and the like, have hitherto been used as criteria.

Patent Document 1: JP-A-2002-174542

Patent Document 2: JP-A-2007-024750

Disclosure of the Invention

Problem that the Invention is to solve

[0007] However, in the above configuration, an appliance is determined through use of a start-up waveform of a flow rate achieved when a gas appliance has initiated use of a gas serving as a fluid or a flow rate value itself. Accordingly, a start-up waveform of the same shape or a waveform of the same flow rate value is acquired, there arises a problem of difficulty being encountered in determining an appliance. Moreover, it has been difficult to determine an operating state of an appliance, much less distinguish usage of an appliance from gas leakage.

[0008] The present invention has been conceived to solve the aforementioned drawback and aims at providing a technique for identifying an appliance which uses the fluid or leakage with high precision by utilization of a change in the flow rate of a fluid.

Means for Solving the Problem

[0009] A flow rate measuring apparatus of the present invention has a flow rate measurement section that measures a flow rate of a fluid flowing in a flow passage; a flow rate information storage section that stores a flow rate value measured by the flow rate measurement section; a measured flow rate value difference calculation section that calculates a measured flow rate value difference within a predetermined period corresponding to an amount of change occurred in a measured flow rate value; and an appliance identifying section that identifies an appliance which uses the fluid or leakage by determining whether or not the measured flow rate value difference is a predetermined threshold or less.

[0010] According to the present invention, an appliance which uses the fluid can be identified from a view-

point of the value difference in a measured flow rate value, whereby a novel method, such as an appliance identification, is provided. Moreover, a higher-precision appliance identifying method, and the like, is provided by combination of the present invention with an existing method.

[0011] Moreover, in the flow rate measuring apparatus of the present invention, the measured flow rate value difference can be defined as a per-measurement flow rate value difference corresponding to an amount of change occurred in a measured flow rate value every time the flow rate measurement section performs measurement; and the appliance identifying section identifies an appliance which uses the fluid or leakage based on a frequency at which the per-measurement flow rate value difference is the threshold or less.

[0012] According to the configuration, an amount of change in a measured flow rate value occurred in each measurement is used. Hence, a novel method, such as appliance identification, is provided, and a higher-precision appliance identification method, and the like, is provided.

[0013] Further, in the flow rate measuring apparatus of the present invention, the measured flow rate value difference can be defined as a per-measurement flow rate value difference corresponding to an amount of change occurred in a measured flow rate value every time the flow rate measurement section performs measurement; and the appliance identifying section identifies an appliance which uses the fluid or leakage based on number of times the per-measurement flow rate value difference, which is the threshold or less, is continually calculated.

[0014] Even in this configuration, an amount of change occurred in a measured flow rate value in each measurement is used. Hence, a novel method, such as appliance identification, is provided, and a higher-precision appliance identification method, and the like, is provided.

[0015] Moreover, in the flow rate measuring apparatus of the present invention, the measured flow rate value difference can be defined as an overall-period measured flow rate value difference corresponding to an amount of change occurred in a measured flow rate value over an entirety of the predetermined period; and the appliance identifying section identifies an appliance which uses the fluid or leakage based on whether or not the overall-period measured flow rate value difference is the threshold or less.

[0016] According to the configuration, an amount of change occurred in a measured flow rate value over a predetermined period is used; hence, a novel method, such as appliance identification, is provided, and a higher-precision appliance identification method, and the like, is provided.

[0017] Furthermore, in the flow rate measuring apparatus of the present invention, the predetermined period can be defined as a period from initiation of operation of the appliance until stoppage of operation of the same or

a portion of a period from initiation of operation of the appliance until stoppage of operation of the same. The portion of period can also be a time achieved in the middle of stable operation of the appliance.

[0018] According to the configuration, an optimum flow rate measurement time or timing can be selected according to the type of an appliance.

[0019] Moreover, a flow rate measuring apparatus of the present invention has a flow rate measurement section that measures a flow rate of a fluid flowing in a flow passage; a flow rate information storage section that stores a flow rate value measured by the flow rate measurement section; a measured flow rate value difference calculation section that calculates a measured flow rate value difference within a predetermined period corresponding to an amount of change occurred in a measured flow rate value; and an appliance operation state determination section that determines an operating state of an appliance which uses the fluid, by determining whether or not the measured flow rate value difference is a predetermined threshold.

[0020] According to the present invention, it is possible to identify an appliance which uses the fluid and also to determine an operating state of the appliance from the viewpoint of the measured flow rate value difference. The present invention can also be applied to another technique, such as enhancement of maintenance.

[0021] Moreover, according to the present invention, a flow rate measurement method performed by the flow rate measuring apparatus and a computer that controls the flow rate measuring apparatus are provided. Further, a fluid supply system using the apparatus, the method, and a program is provided.

Advantage of the Invention

[0022] According to the present invention, a novel method for identifying an appliance, determining an operating state of the appliance, and distinguishing usage of the appliance from gas leakage is provided. A higher-precision appliance identifying method, an appliance operating state determination method, and a method for distinguishing usage of an appliance from gas leakage are provided.

Brief Description of the Drawings

[0023] Fig. 1 is a block diagram of a flow rate measuring apparatus of an embodiment of the present invention.

Fig. 2 is a graph conceptually showing a change in flow rate of a gas appliance.

Figs. 3(a) and 3(b) are conceptual graphs rendering for determining whether or not a value difference in measured flow rate value acquired every measurement during stable operation of a gas appliance is a predetermined threshold or less; in other words, a view acquired when the value difference in flow rate

value is small.

Figs. 4(a) and 4(b) are conceptual graphs rendering for determining whether or not the value difference in measured flow rate value acquired every measurement during stable operation of a gas appliance is a predetermined threshold or less, or a view acquired when the value difference in flow rate value is great.

Fig. 5 is a conceptual rendering for determining whether or not the value difference in flow rate value measured by twice measurement operations is a predetermined threshold or less in the middle of stable operation of a gas appliance.

Figs. 6(a) and 6(b) are views showing a change in flow rate achieved in an operation mixedly including cases where the measured flow rate value difference exceeds the threshold and cases where the same does not exceed the threshold.

Figs. 7(a) and 7(b) are conceptual graphs rendering for determining whether or not the value difference in measured flow rate value arising during stable operation of a gas appliance and throughout the entirety of a predetermined period is a predetermined threshold or less.

Fig. 8 is a block diagram of a related-art flow rate measuring apparatus.

Fig. 9 is a block diagram of another related-art flow rate measuring apparatus.

Descriptions of Reference Numerals and Symbols

[0024] 7 ULTRASONIC FLOW RATE MEASURING DEVICE (FLOW RATE MEASUREMENT SECTION)

8 MEASURED FLOW RATE INFORMATION STORAGE SECTION

9 MEASURED FLOW RATE VALUE DIFFERENCE CALCULATION SECTION

11 APPLIANCE IDENTIFYING SECTION

13, 14, 15 GAS APPLIANCE

16 GAS METER (FLOW RATE MEASURING APPARATUS)

Best Mode for Implementing the Invention

[0025] An embodiment of the present invention will hereinafter be described by reference to the drawings.

[0026] Fig. 1 show a block diagram of a gas meter 16 working as a flow rate measuring apparatus of the embodiment of the present invention.

[0027] In Fig 1, the gas meter 16 has a flow passage 6, an ultrasonic flow rate measuring device 7, a measured flow rate information storage section 8, a measured flow rate value difference calculation section 9, and an appliance identifying section 11. The gas meter 16 is disposed in the flow passage 6 and includes a flow passage shutoff valve 17 for shutting off gas in the event of emergency and an appliance-specific flow rate calculation section

20.

[0028] The ultrasonic flow rate measuring device 7 measures a flow rate of gas serving as a fluid that flows in the flow passage 6 by emitting an ultrasonic wave to the gas, and a common ultrasonic flow measurement device can be used. The measured flow rate information storage section 8 stores object data that describe a flow rate value measured by the ultrasonic flow rate measuring device 7 and a measurement time during which the flow rate value has been measured while associating them with each other.

[0029] As will be described later, the measured flow rate value difference calculation section 9 calculates the value difference corresponding to a change in the measured flow rate value of the object data stored in the measured flow rate information storage section 8 (i.e., the measured flow rate value difference). As will be described later, the value difference includes 1) a per-measurement flow rate value difference corresponding to the amount of a change in measured flow rate value acquired every time the ultrasonic flow rate measuring device 7 performs measurement; 2) an overall-period measured flow rate value difference (i.e., the amount of change in absolute value) corresponding to the amount of change in measured flow rate value achieved over an entire predetermined period; and the like.

[0030] As will be described later, the appliance identifying section 11 identifies, from a result of a determination about whether the aforementioned value difference is a predetermined threshold or less, whether the change is caused by a gas appliance which uses the fluid or by leakage. The appliance-specific flow rate calculation section 20 calculates a flow rate of each gas appliance identified by the appliance identifying section 11. The gas meter 16 is connected to a gas pipe line 19 at an upstream position and connected to various gas appliances 13, 14, and 15, such as a gas cooker, a fan heater, and a floor heater, at downstream positions.

[0031] Operation and action of the above-configured flow rate measuring apparatus are described while attention is paid particularly on operation and action of the measured flow rate value difference calculation section 9 and the appliance identifying section 11.

[0032] Fig. 2 is a graph conceptually showing a change in the flow rate of the gas flowing in the gas meter 16 that results from use of a gas appliance and that is measured by the ultrasonic flow rate measuring device 7. The flow rate is stored in the measured flow rate information storage section 8 in the form of object data associated with a measurement time (namely in the form of this graph). For instance, when the flow rate measured by the ultrasonic flow rate measuring device 7 has changed from zero to a predetermined amount, one appliance is determined to have started operating. The measured flow rate information storage section 8 starts storing an hourly change in measured flow rate acquired at this time as a measured flow rate value. Specifically, the measured flow rate information storage section 8 stores, as object

data, a flow rate value measured at a predetermined measurement time interval (e.g., every two seconds) while associating the flow rate value with a measurement time began from a time when a change occurred.

[0033] A waveform of a flow rate shown in Fig. 2 generally varies from one gas appliance to another. Accordingly, a method for determining a gas appliance from such a waveform has hitherto been known. Although there are various determination methods, a known method is to determine a gas appliance by use of; for instance, a start-up waveform of a flow rate indicated by an area A and a flow rate value acquired in the middle of stable operation of the gas appliance indicated by an area B (operation performed at a time when a flow rate value achieved after start-up operation becomes substantially stable). However, in relation to some gas appliances, start-up waveforms of substantially-identical shape and waveforms of substantially-identical flow rate value are often appear. In such a case, difficulty is encountered in determining a gas appliance. Moreover, when gas leakage substantially identical with a gas appliance in terms of the quantity of flow is present, it becomes difficult to distinguish use of an appliance from gas leakage.

[0034] In the present invention, attention is paid to a point differing from the shape of a waveform or a flow rate value. Specifically, the gas meter of the present invention determines a gas appliance used or leakage from the value difference in flow rate value representing the amount of change in a gas flow rate value (the measured flow rate value difference). In the following embodiment, there is introduced an example for distinguishing a gas appliance from leakage by observing an area C in Fig. 2; namely, the value difference (a change in flow rate value) achieved in the middle of stable operation of a gas appliance.

[0035] Figs. 3(a) to 4(b) show examples for determining a gas appliance by use of the value difference in measured flow rate value acquired for each measurement corresponding to the amount of change in a measured flow rate value acquired by the ultrasonic flow rate measuring device 7 for each measurement. Figs. 3(a) and 3(b) show that such a per-measurement flow rate value difference is smaller (than a predetermined threshold), and Figs. 4(a) and 4(b) show that such a per-measurement flow rate value difference is greater (than a predetermined threshold).

[0036] Fig. 3(a) shows a graph of a measurement time and a measured flow rate value that are acquired by the ultrasonic flow rate measuring device 7 for each measurement. Data showing a combination of such a measurement time and such a measured flow rate value (object data) are stored in the measured flow rate information storage section 8 that is predetermined memory.

[0037] The measured flow rate value difference calculation section 9 calculates a measured flow rate value difference corresponding to the amount of change in measured flow rate value within a predetermined period of time. In particular, in the present embodiment, the

measured flow rate value difference calculation section 9 calculates, as the measured flow rate value difference, the amount of change in measured flow rate value for each measurement performed by the ultrasonic flow rate measuring device 7 (the per-measurement flow rate value difference) within a predetermined period of time indicated by C. In Fig. 3(a), the per-measurement flow rate value difference is Δq_1 , Δq_2 , ..., Δq_i .

[0038] The appliance identifying section 11 identifies a gas appliance that uses gas by determining whether or not the measured flow rate value difference is a predetermined threshold Δq_m or less. In the present embodiment, the appliance identifying section 11 identifies a gas appliance on the basis of the number of times the per-measurement flow rate value differences (Δq_1 , Δq_2 , ..., Δq_i) are continually calculated as being a predetermined threshold Δq_m or less by the measured flow rate value difference calculation section 9. The threshold Δq_m is given as a unique value difference for each gas appliance and stored in unillustrated memory (a threshold storage section).

[0039] Fig. 3(b) is a graph showing, as an integrated frequency, the continual number of times a per-measurement flow rate value difference smaller than the predetermined threshold Δq_m is calculated, wherein the number is acquired by the appliance identifying section 11. Fig. 3(b) shows that the per-measurement flow rate value difference is the threshold Δq_m or less continually five times within the predetermined period C ($|\Delta q_i| < \Delta q_m$). When the per-measurement flow rate value difference that is the threshold or less is continually acquired five times as mentioned above, the appliance identifying section 11 identifies the gas appliance being used as a specific gas appliance (e.g., a fan heater).

[0040] Figs. 4(a) and 4(b) are analogous to Figs. 3(a) and 3(b). As shown in Fig. 4(a), an example in which the per-measurement flow rate value differences $\Delta q_1'$, $\Delta q_2'$, ..., $\Delta q_i'$ calculated by the measured flow rate value difference calculation section 9 are greater than Δq_1 , Δq_2 , ..., Δq_i shown in Fig. 3(a); namely, an example of great variations in gas flow rate value. Since all of the per-measurement flow rate value differences $\Delta q_1'$, $\Delta q_2'$, ..., $\Delta q_i'$ are greater than the threshold Δq_m ($|\Delta q_i| \geq \Delta q_m$), the integrated frequency still remains zero as shown in Fig. 4(b). When the per-measurement flow rate value difference equal to or greater than the threshold is continually obtained five times as mentioned above, the appliance identifying section 11 identifies the gas appliance being used as a specific gas appliance (e.g., a hot water supply).

[0041] The embodiments shown in Figs. 3(a) to 4(b) provide examples in which fluctuations in flow rate are repeated every time measurement is performed. However, the flow rate does not always exhibit such a behavior. Even in a case differing from the embodiments shown in Figs. 3(a) to 4(b), data acquired on a per-measurement basis can be used. However, when a continual increase arises in a flow rate, data acquired before the flow rate

next turns to a decrease can be considered as a measurement unit. Alternatively, when a continual decrease arises in a flow rate, data acquired before the flow rate next turns-into an increase can be considered as a measurement unit. For instance, in an embodiment shown in Fig. 5, fluctuations in flow rate are not repeated for each measurement but every two measurement operations. In such a case, the appliance identifying section 11 perceives an aggregate amount of flow rate continually increased during two measurement operations or an aggregate amount of flow rate continually decreased during two measurement operations as per-measurement flow rate value differences Δq_1 , Δq_2 , ..., Δq_i . The per-measurement flow rate value differences are compared with the threshold Δq_m , whereby integrated frequencies, such as those shown in Fig. 4(b), can be acquired. The word "measurement-by-measurement" in the "per-measurement flow rate value difference" can also be considered as a predetermined unit time for perceiving the value difference and can also be considered as actual one measurement operation of the ultrasonic flow rate measuring device 7.

[0042] Although the drawings illustrate data acquired every two measurement operations, various situations arise; for instance, actually fluctuations arise three times or only one time. Specifically, the aforementioned descriptions are provided on condition that the timing at which the value difference is determined is a given cycle. However, the present invention is not limited to such a mode. For instance, a difference between the maximum flow rate and the minimum flow rate acquired in a period during which the flow rate increases or decreases can also be compared with a threshold. In general, a time during which the flow rate continually increases or a time during which the flow rate continually decreases is not constant. In such a case, a predetermined period during which the flow rate is detected in order to calculate the measured flow rate value difference; namely, a detection time, is not fixed to a given time but various from time to time.

[0043] In the embodiment shown in Figs. 3(a) to 4(b), the appliance identifying section 11 is arranged so as to identify a gas appliance being used on the basis of the continual number of times per-measurement flow rate value difference of a threshold or less is acquired. The continual number of times is set to five in the above descriptions. However, the continual number of times is arbitrary.

[0044] An actual operating time of an appliance; namely, a predetermined time, is long, and cases shown in Figs. 3(a) to 4(b) may mixedly arise. In such a case, when the measured flow rate value difference has come to the threshold or more, the appliance identifying section 11 can be arranged so as to temporarily reset an integrated frequency counter and resume counting of an integrated frequency at a time point when the count has again become smaller than the threshold. For instance, as shown in Fig. 6(a), widths Δq_4 and Δq_5 exceed the predeter-

mined threshold Δq_m in an embodiment shown in Figs. 6(a) and 6(b). As shown in Fig. 6(b), the integrated frequency counter is reset at points in time t_4 and t_5 , and counting of the integrated frequency is resumed from a time point t_6 . In relation to a criterion, a determination can also be made based on a ratio of occurrences of a case where the number of continual integrated frequencies exceeds a predetermined value to occurrences of a case where the same does not exceed the predetermined value.

[0045] Alternatively, in addition to application of the continual number of times, application of another indicator is also possible. For instance, the appliance identifying section 11 can also identify a gas appliance on the basis of a frequency at which the per-measurement flow rate value difference of a predetermined threshold or less appears. The following indicators can also be employed; for instance, an indicator suggesting that a gas appliance is identified as a fan heater when six out of ten value differences are the threshold or less, an indicator suggesting that a gas appliance is identified as a hot water supply when only two out of the ten value differences are the threshold or less.

[0046] In contrast with the embodiment shown in Figs. 3(a) to 4(b), an embodiment shown in Figs. 7(a) and 7(b) is a case of use of an overall-period measured flow rate value difference corresponding to the amount of change in measured flow rate value achieved during stable operation of a gas appliance over an entire predetermined period (i.e., the amount of change in absolute value). Specifically, after a flow rate value measured over the entirety of the predetermined period B has been stored in the measured flow rate value information storage section 8, an overall-period measured flow rate value difference Δq that is a value difference in all measured flow rate values is calculated by the measured flow rate value difference calculation section 9.

[0047] As shown in Fig. 7(a), when the overall-period measured flow rate value difference Δq is smaller than the predetermined threshold Δq_m , the appliance identifying section 11 identifies a gas appliance being used as; for instance, a specific gas appliance (e.g., a fan heater). Meanwhile, when the overall-period measured flow rate value difference Δq is greater than the predetermined threshold Δq_m as shown in Fig. 7(b), the appliance identifying section 11 identifies a gas appliance being used as; for instance, a specific gas appliance (e.g., a hot water supply). An actual operating time of an appliance; namely, a predetermined time, is long, and cases shown in Figs. 7(a) and (b) may mixedly arise. In such a case, an identification can also be made based on a ratio between the cases.

[0048] In the embodiments shown in Figs. 3(a) through 7(b), a predetermined period during which there is acquired a measured flow rate value serving as a basis for determining the value difference is taken as C representing a time during which a gas appliance stably operates. However, the predetermined period may also be another

portion of a period from initiation of operation of a gas appliance to stoppage of operation of the same. Further, the predetermined period may also be a period from initiation of operation of a gas appliance to stoppage of operation of the same.

[0049] In the foregoing embodiments, a gas appliance being used is identified by use of the measured flow rate value difference. However, identification of operating state of a specific gas appliance as well as identification of a gas appliance become possible by application of the present invention. For instance, the value difference of a single appliance, such as the gas cooker, sometimes changes between where a gas cooker is normally performing combustion after started operation and where the gas cooker is not normally performing combustion (where incomplete combustion or a flame failure has occurred), as shown in Figs. 3(a) to 4(b). Moreover, the value difference varies as shown in Figs. 7(a) and 7(b). It becomes possible to determine whether or not the gas appliance is normally operating or identify the nature of operation by capturing these fluctuations in the value difference. Such identification can be applied to; for instance, safety maintenance inspection of a gas appliance. In this case, the appliance identifying section 11 works as an appliance operating status determination section that determines an operating state of a gas appliance.

[0050] In the embodiment, a gas appliance being used is identified by use of the measured flow rate value difference. However, it also becomes possible to determine an operating state of a specific gas appliance as well as to identify a gas appliance by application of the present invention. For instance, the value difference in a single appliance, such as a hot water supply, sometimes varies between where the hot water supply is performing combustion at a great flow rate after starting operation and where the same is performing combustion at a small flow rate. It becomes possible to determine whether or not the gas appliance is performing combustion at a great flow rate or a small flow rate by capturing these fluctuations in the value difference. The determination can be applied to; for instance, safety maintenance inspection of a gas appliance. In this case, the appliance identifying section 11 works as an appliance operating state determination section that determines an operating state of a gas appliance.

[0051] In the aforementioned embodiment, a gas appliance being used is identified by use of the measured flow rate value difference. However, it also becomes possible to distinguish usage of a gas appliance from gas leakage as well as to identify a gas appliance by application of the present invention. For instance, the value difference sometimes varies between where the gas appliance is normally performing combustion and where gas substantially identical in quantity with the gas used by the gas appliance is still leaking, as shown in Figs. 3(a) to 4(b). Moreover, the value difference varies as shown in Figs. 7(a) and 7(b). It becomes possible to de-

termine whether the gas appliance is being used or gas is leaking, by capturing these fluctuations in the value difference. In general, a narrow value difference corresponds to the case of leakage. In this case, the appliance identifying section 11 distinguishes usage of an appliance from gas leakage. The determination can be applied to; for instance, safety maintenance inspection of gas leakage.

[0052] In the embodiment, the continual number of times the per-measurement flow rate value difference of the predetermined threshold Δq_m or less is calculated, which is obtained by the appliance identifying section 11, is taken as an integrated frequency. However, the continual number of times the per-measurement flow rate value difference of the predetermined threshold Δq_m or more is calculated, which is obtained by the appliance identifying section 11, can also be taken as an integrated frequency.

[0053] In general, since gas leakage is not accompanied by a flow rate fluctuation factor, such as combustion, gas leakage is assumed to entail a comparatively-narrow value difference in flow rate and hence can be distinguished from a gas appliance. Above all, a hot water supply that instantaneously performs gas flow rate control entails a wide value difference of flow rate change and can be distinguished from leakage more clearly.

[0054] With regard to the identification utilizing the threshold described in connection with the present patent application, classifying a state into two categories by means of a threshold is important. Therefore, when a state matches a threshold, the essential requirement for determining which one of the two categories applies to the state is to make a determination, as required, according to an objective.

[0055] In order to implement the flow rate measurement method, such as that mentioned above, a program for carrying out processing pertaining to respective steps of the flow rate measurement method is stored in the appliance identifying section 11 or an unillustrated computer (an arithmetic-logic unit) of the gas meter 16. Further, the present invention also encompasses the flow rate measuring apparatus of the present invention, the flow rate measurement method of the same, and a fluid supply system including a fluid (gas) supply source that uses a program to be executed by a computer.

[0056] The above descriptions are directed to a case where the ultrasonic flow rate measuring apparatus is used. However, it is manifest that similar advantages are yielded by another instantaneous flow rate measuring apparatus. Explanations about processing to be performed after identification of an appliance or determination of leakage are omitted. However, in the gas meter, it is obvious that setting an appliance-specific charge on the basis of measurement of an integrated flow rate for each of groups categorized according to registered appliances or setting an appliance-specific maintenance function for safety management (safety maintenance function) for each of groups categorized according to reg-

istered appliances is possible. Further, in the case of gas leakage, it is manifest that maintenance processing, such as a report, shutoff of gas, or a combination thereof, is also possible. Further, so long as a gas meter and a gas appliance can be equipped with a transceiver, such as a wireless device, expectation of further enhanced identification of an appliance or determination of leakage is evident. Although the descriptions are provided by means of the gas meter and the gas appliances, the present invention can also be used similarly for grouping appliances to be used, which are connected to positions downstream of the flow rate measuring apparatus, even in the case of an industrial flow rate measuring apparatus or a water meter.

[0057] The present patent application is based on Japanese Patent Application No. 2007-119764 filed on April 27, 2007; Japanese Patent Application No. 2007-189656 filed on July 20, 2007; and Japanese Patent Application No. 2008-058135 5 filed on March 7, 2008, contents of which are incorporated herein by reference.

[0058] Although the embodiments of the present invention have been described thus far, the present invention is not limited to matters provided in the embodiments, and modifications and applications of the invention which will be made by those skilled in the art on the basis of the descriptions of the specification and the known arts are also intended and conceived to fall within the scope of protection to be sought.

Industrial Applicability

[0059] As mentioned above, the present invention makes it possible to identify an appliance which uses the fluid from the viewpoint of the value difference in flow rate value, and a new method, such as an appliance identification, is provided. Further, a technique which will serve as a basis for a more-precise appliance identification method, and the like, is provided.

Claims

1. A flow rate measuring apparatus comprising:

a flow rate measurement section that measures a flow rate of a fluid flowing in a flow passage;
a flow rate information storage section that stores a measured flow rate value measured by the flow rate measurement section;
a measured flow rate value difference calculation section that calculates a measured flow rate value difference within a predetermined period corresponding to an amount of change occurred in the measured flow rate value; and
an appliance identifying section that identifies an appliance which uses the fluid or leakage by determining whether or not the measured flow rate value difference is a predetermined thresh-

old or less.

2. The flow rate measuring apparatus according to claim 1, wherein the measured flow rate value difference is a per-measurement flow rate value difference corresponding to an amount of change occurred in a measured flow rate value every time the flow rate measurement section performs measurement; and
the appliance identifying section identifies an appliance which uses the fluid or leakage based on a frequency at which the per-measurement flow rate value difference is the threshold or less.
3. The flow rate measuring apparatus according to claim 1, wherein the measured flow rate value difference is a per-measurement flow rate value difference corresponding to an amount of change occurred in a measured flow rate value every time the flow rate measurement section performs measurement; and
the appliance identifying section identifies an appliance which uses the fluid or leakage based on number of times the per-measurement flow rate value difference, which is the threshold or less, is continually calculated.
4. The flow rate measuring apparatus according to claim 1, wherein the measured flow rate value difference is an overall-period measured flow rate value difference corresponding to an amount of change occurred in a measured flow rate value over an entirety of the predetermined period; and
the appliance identifying section identifies an appliance which uses the fluid or leakage based on whether or not the overall-period measured flow rate value difference is the threshold or less.
5. The flow rate measuring apparatus according to any one of claims 1 through 4, wherein the predetermined period is a period from initiation of operation of the appliance until stoppage of operation of the same.
6. The flow rate measuring apparatus according to any one of claims 1 through 4, wherein the predetermined period is a portion of a period from initiation of operation of the appliance until stoppage of operation of the same.
7. The flow rate measuring apparatus according to claim 6, wherein the portion of period is a time achieved in the middle of stable operation of the appliance.
8. A flow rate measuring method comprising:

a step of measuring a flow rate of a fluid flowing

in a flow passage;
 a step of storing a measured flow rate value;
 a step of calculating, within a predetermined period, a measured flow rate value difference corresponding to an amount of change occurred in a measured flow rate value; and
 a step of identifying an appliance which uses the fluid or leakage by determining whether or not the measured flow rate value difference is a predetermined threshold or less.

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9. A program for using a computer that controls a flow rate measuring apparatus to execute processing pertaining to the following steps:

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a step of measuring a flow rate of a fluid flowing in a flow passage;
 a step of storing a measured flow rate value;
 a step of calculating, within a predetermined period, a measured flow rate value difference corresponding to an amount of change occurred in a measured flow rate value; and
 a step of identifying an appliance which uses the fluid or leakage by determining whether or not the measured flow rate value difference is a predetermined threshold or less.

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10. A fluid supply system using the flow rate measuring apparatus, the flow rate measurement method, or a program to be executed by a computer, according to any one of claims 1 through 9.

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11. A flow rate measuring apparatus comprising:

a flow rate measurement section that measures a flow rate of a fluid flowing in a flow passage;
 a flow rate information storage section that stores a flow rate value measured by the flow rate measurement section;
 a measured flow rate value difference calculation section that calculates, within a predetermined period, a measured flow rate value difference corresponding to an amount of change occurred in a measured flow rate value; and
 an appliance operation state determination section that determines an operating state of an appliance which uses the fluid, by determining whether or not the measured flow rate value difference is a predetermined threshold or less.

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FIG. 1

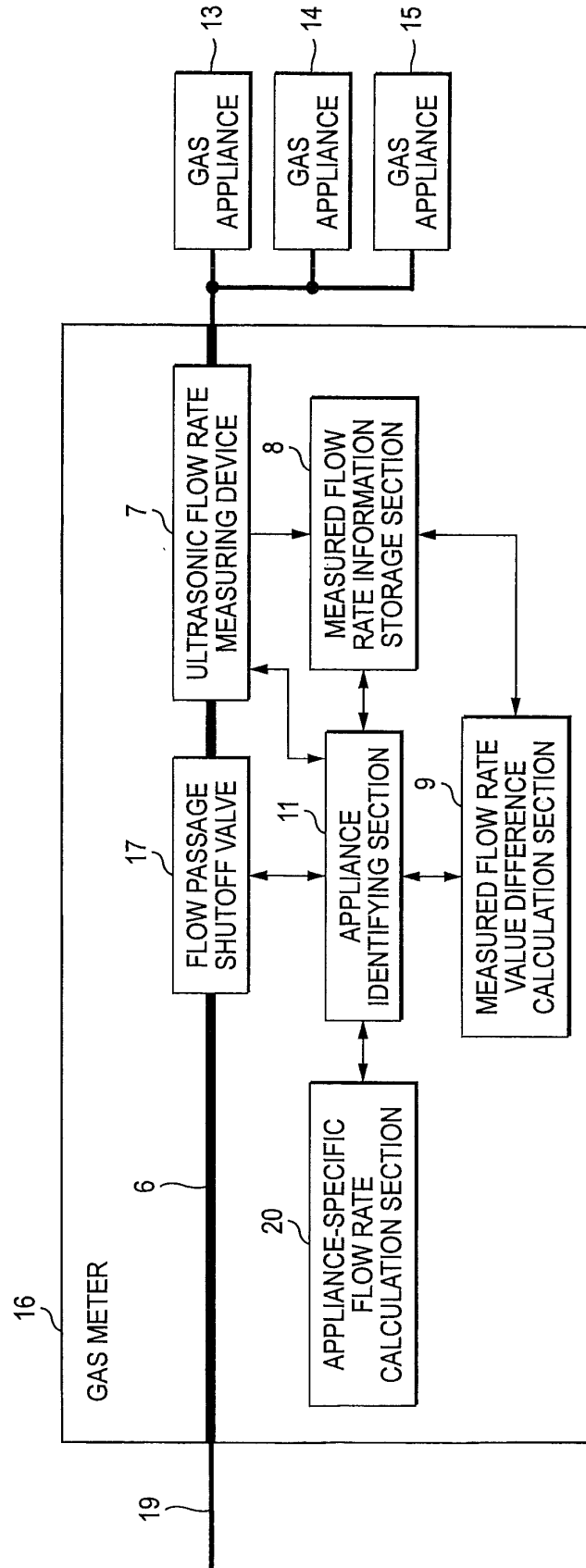


FIG. 2

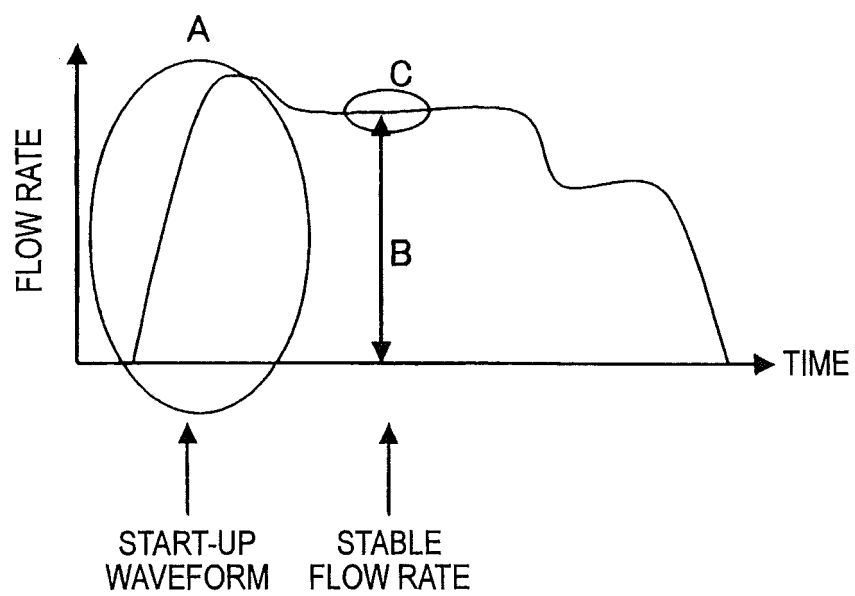


FIG. 3 (a)

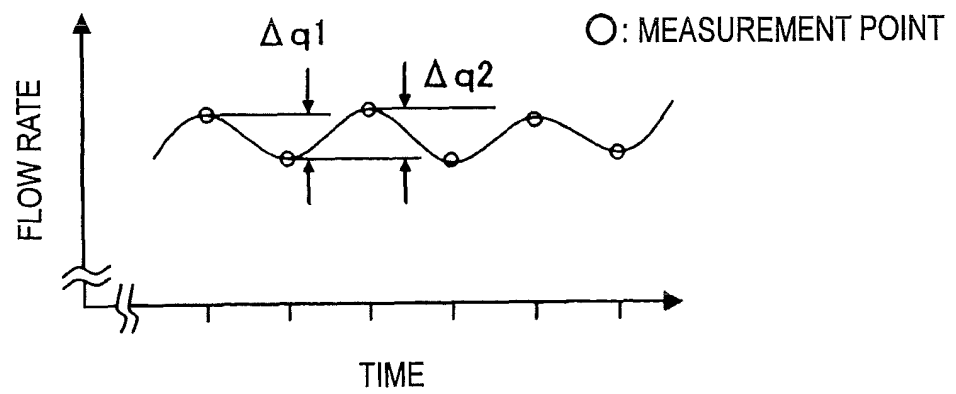


FIG. 3 (b)

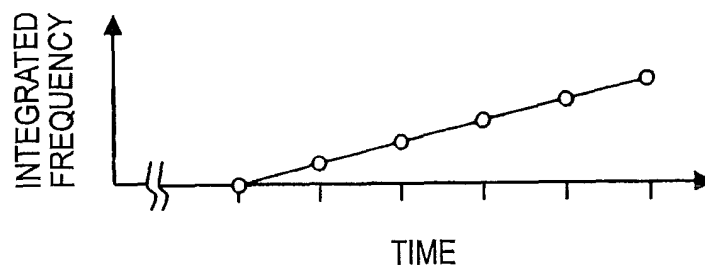


FIG. 4 (a)

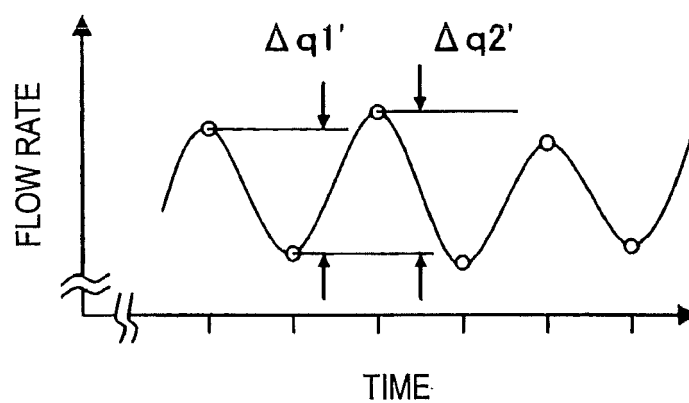


FIG. 4 (b)

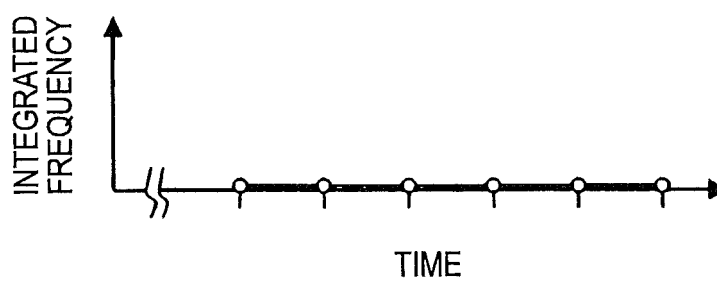


FIG. 5

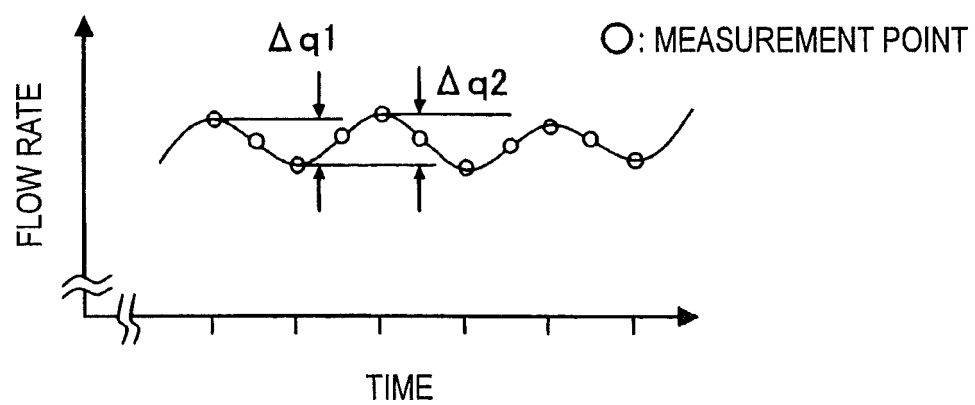


FIG. 6 (a)

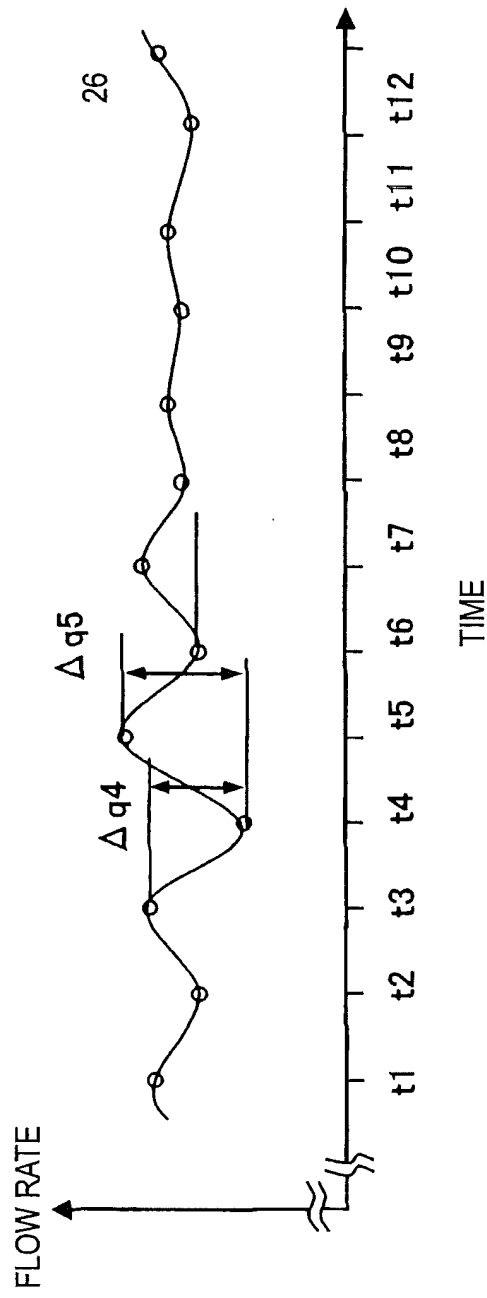


FIG. 6 (b)

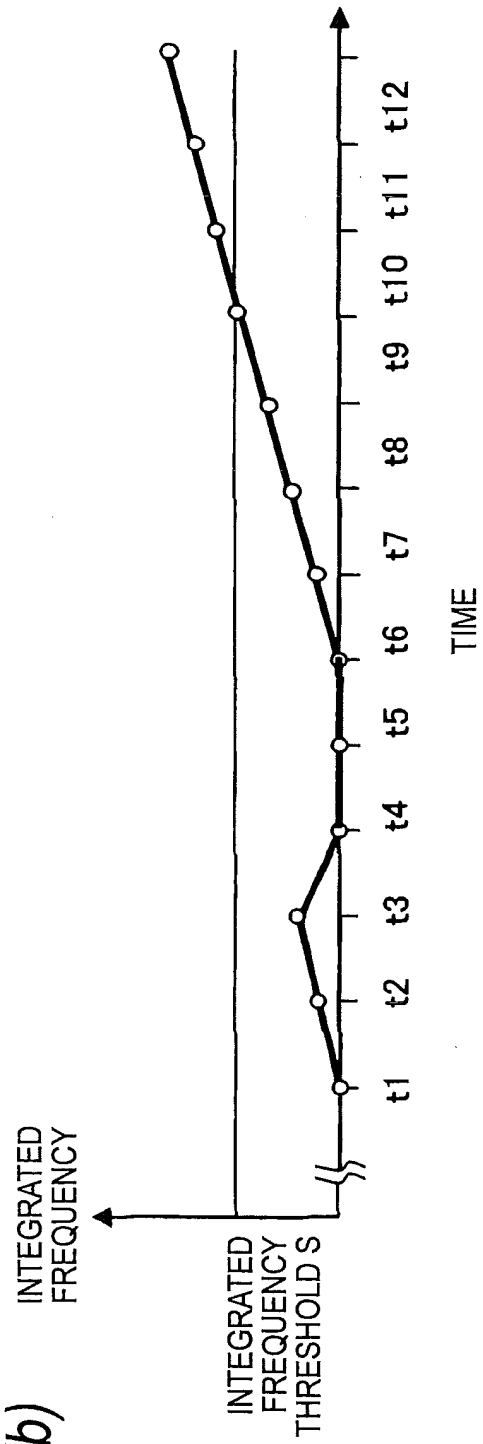


FIG. 7 (a)

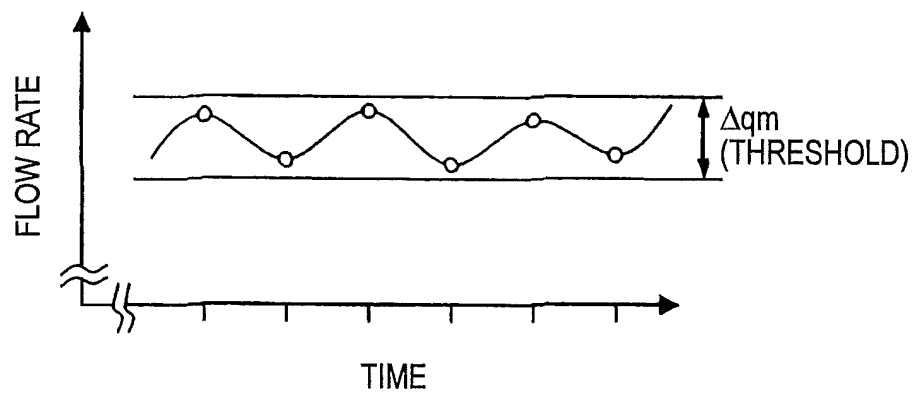


FIG. 7 (b)

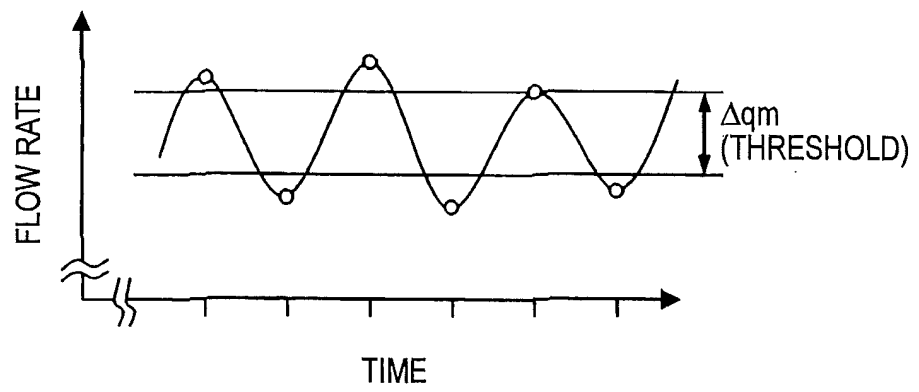


FIG. 8

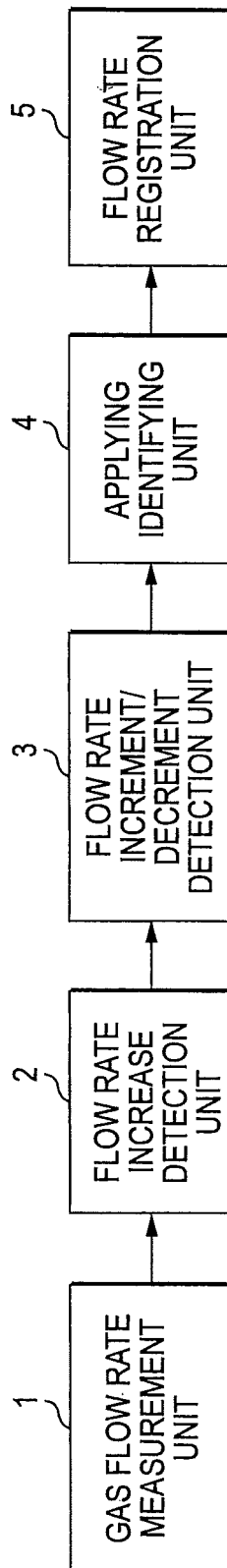
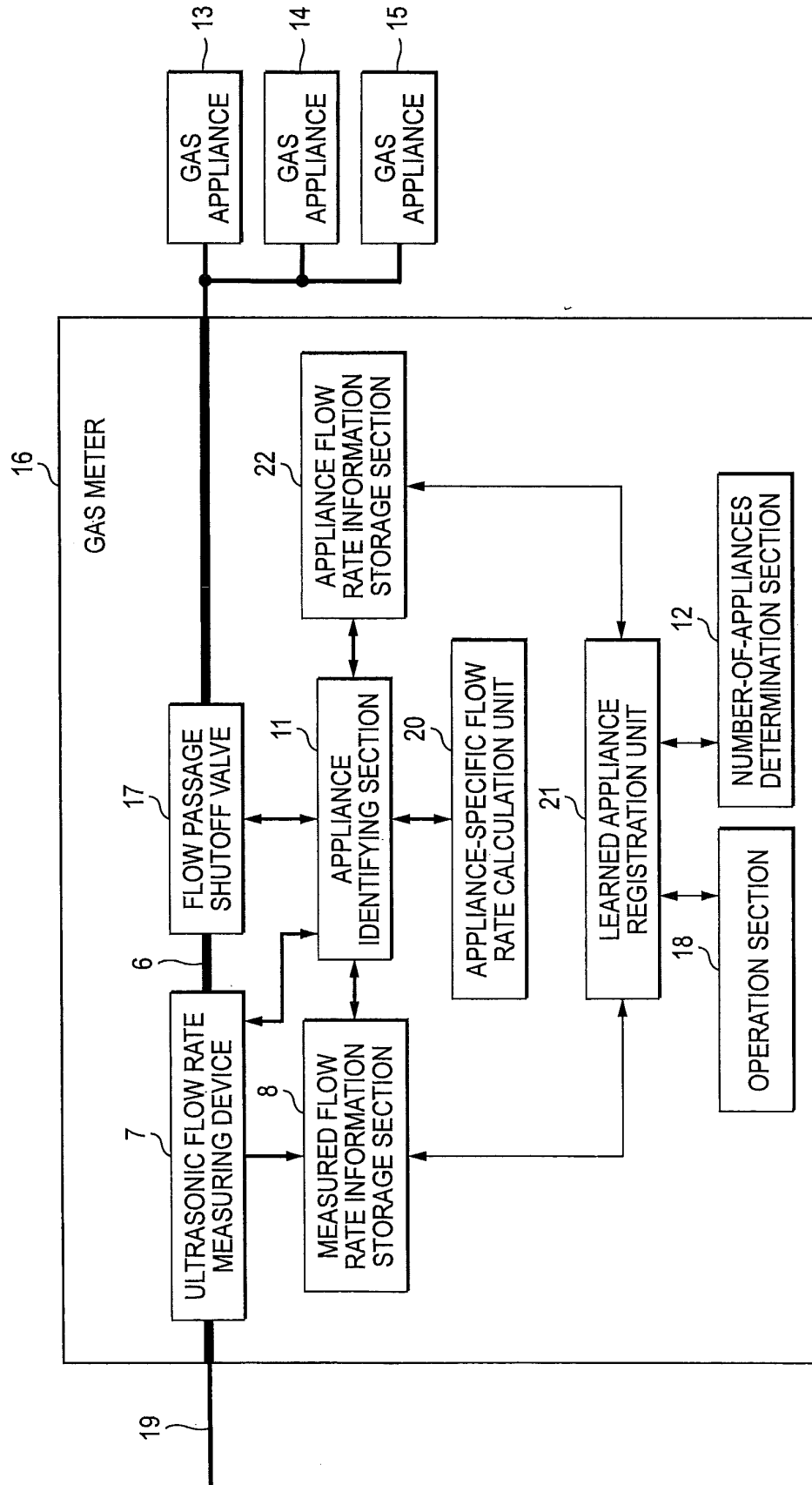


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/001104

A. CLASSIFICATION OF SUBJECT MATTER

G01F3/22(2006.01)i, F23N5/18(2006.01)i, F23N5/24(2006.01)i, G01F1/66(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01F3/22, F23N5/18, F23N5/24, G01F1/66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2007-24813 A (Matsushita Electric Industrial Co., Ltd.), 01 February, 2007 (01.02.07), Par. Nos. [0025] to [0031], Figs. 2-1, 2-2, 3 (Family: none)	1, 4, 6-10 2, 3, 5, 11
X A	JP 2000-227350 A (Osaka Gas Co., Ltd.), 15 August, 2000 (15.08.00), Par. Nos. [0011] to [0015]; Figs. 1 to 3 (Family: none)	11 1-10
A	JP 2007-24748 A (Matsushita Electric Industrial Co., Ltd.), 01 February, 2007 (01.02.07), Full text; all drawings (Family: none)	1-11

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
22 May, 2008 (22.05.08)Date of mailing of the international search report
03 June, 2008 (03.06.08)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/001104

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-24807 A (Matsushita Electric Industrial Co., Ltd.), 01 February, 2007 (01.02.07), Full text; all drawings (Family: none)	1-11
A	JP 2003-222548 A (Matsushita Electric Industrial Co., Ltd.), 08 August, 2003 (08.08.03), Par. Nos. [0048] to [0054]; Figs. 5, 6 (Family: none)	1-11

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002174542 A [0006]
- JP 2007024750 A [0006]
- JP 2007119764 A [0057]
- JP 2007189656 A [0057]
- JP 2008581355 A [0057]